# 2.3 Quadratic Equations: Factorising, the Formula and Completing the Square: 2-hour Pack

AQA 8365 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** Solve $12x^2 + 29x + 14 = 0$.

**(Total for Question 1 is 3 marks)**

**2** Solve $x(x + 1) = 4x + 18$.

**(Total for Question 2 is 4 marks)**

**3** Solve $x^2 + 16x + 5 = 0$ by completing the square. Give your answers as surds in their simplest form.

**(Total for Question 3 is 4 marks)**


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**4** Solve $4x^2 + 27x - 40 = 0$.

**(Total for Question 4 is 3 marks)**

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**5** A rectangular patio has width x metres and length (x + 5) metres. Its area is 150 square metres. Form and solve a quadratic equation to find x, and hence find the perimeter of the rectangle.

**(Total for Question 5 is 5 marks)**

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**6** Solve $3x^2 - 14x - 24 = 0$.

**(Total for Question 6 is 3 marks)**

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**7** Solve $x^2 - 6x - 6 = 0$. Give your solutions correct to 3 significant figures.

**(Total for Question 7 is 3 marks)**


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**8** Solve $x^2 + 12x - 15 = 0$ by completing the square. Give your answers as surds in their simplest form.

**(Total for Question 8 is 4 marks)**

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**9** Solve $x(x + 12) = 5x - 10$.

**(Total for Question 9 is 4 marks)**

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**10** A rectangular patio has width x metres and length $(x + 3)$ metres. Its area is 88 square metres. Form and solve a quadratic equation to find x, and hence find the perimeter of the rectangle.

**(Total for Question 10 is 5 marks)**

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**11** Find the values of k for which $9x^2 + kx + 1 = 0$ has equal roots.

**(Total for Question 11 is 3 marks)**


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**12** Solve $x^2 + 8x + 11 = 0$ by completing the square. Give your answers as surds in their simplest form.

**(Total for Question 12 is 4 marks)**

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**13** Solve $x(x + 7) = 7x + 4$.

**(Total for Question 13 is 4 marks)**

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**14** Find the values of k for which $8x^2 + kx + 8 = 0$ has two distinct real roots.

**(Total for Question 14 is 3 marks)**

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**15** Solve $3x^2 - 7x - 3 = 0$. Give your solutions correct to 3 significant figures.

**(Total for Question 15 is 3 marks)**


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**16** Solve $x(x + 2) = 7x + 14$.

**(Total for Question 16 is 4 marks)**

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**17** A rectangular poster has width x metres and length $(x + 7)$ metres. Its area is 120 square metres. Form and solve a quadratic equation to find x, and hence find the perimeter of the rectangle.

**(Total for Question 17 is 5 marks)**

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**18** Solve $x^2 + 4x + 2 = 0$. Give your solutions correct to 3 significant figures.

**(Total for Question 18 is 3 marks)**

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**19** Solve the equation $4x^2 - 12x + 5 = 0$ by factorising.

**(Total for Question 19 is 4 marks)**


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**20** Solve $3x^2 + 5x - 7 = 0$ using the quadratic formula. Give your answers correct to 2 decimal places.

**(Total for Question 20 is 4 marks)**

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**21** Solve $2x^2 - 7x - 3 = 0$ using the quadratic formula. Give your answers correct to 2 decimal places.

**(Total for Question 21 is 2 marks)**

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**22** By completing the square, write $x^2 + 8x + 5$ in the form $(x+p)^2 + q$, where p and q are constants.

**(Total for Question 22 is 2 marks)**

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**23** Factorise fully $6x^2 - 5x - 6$

**(Total for Question 23 is 2 marks)**

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**24** Solve the equation $6x^2 + 5x - 4 = 0$ by factorising.

**(Total for Question 24 is 2 marks)**


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**25** Solve $x^2 - 8x + 5 = 0$ by completing the square. Give your answer in simplified surd form.

**(Total for Question 25 is 4 marks)**

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**26** The curve $y = x^2 - 3x - 4$ and the line $y = 2x - 8$ intersect at two points. Find the coordinates of both points of intersection.

**(Total for Question 26 is 5 marks)**

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**27** Solve the equation $x^4 - 13x^2 + 36 = 0$.

**(Total for Question 27 is 5 marks)**

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**28** Solve the equation $x^4 - 10x^2 + 9 = 0$.

**(Total for Question 28 is 5 marks)**


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# Mark scheme · 2.3 Quadratic Equations: Factorising, the Formula and Completing the Square: 2-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

## Question 1

| | |
|---|---|
| factorises as $(4x + 7)(3x + 2)$ or substitutes correctly into the formula | **M1** |
| one correct root | **A1** |
| $x = -7/4$ or $x = -2/3$ cao | **A1** |

**Answer: $x = -7/4$ or $x = -2/3$**

## Question 2

| | |
|---|---|
| expands the bracket | **M1** |
| rearranges to $x^2 - 3x - 18 = 0$ | **M1** |
| factorises or substitutes into the formula | **M1** |
| $x = -3$ or $x = 6$ cao | **A1** |

**Answer: $x = -3$ or $x = 6$**

## Question 3

| | |
|---|---|
| $(x + 8)^2$ seen | **M1** |
| $(x + 8)^2 = 59$ | **M1** |
| $x + 8 = \pm \sqrt{59}$ | **M1** |
| $x = -8 + \sqrt{59}$ or $x = -8 - \sqrt{59}$ cao | **A1** |

**Answer: $x = -8 + \sqrt{59}$ or $x = -8 - \sqrt{59}$**

## Question 4

| | |
|---|---|
| factorises as $(x + 8)(4x - 5)$ or substitutes correctly into the formula | **M1** |
| one correct root | **A1** |
| $x = -8$ or $x = 5/4$ cao | **A1** |

**Answer: $x = -8$ or $x = 5/4$**

## Question 5

| | |
|---|---|
| $x(x + 5) = 150$ | **M1** |
| $x^2 + 5x - 150 = 0$ | **M1** |
| factorises or solves | **M1** |
| $x = 10$ with the negative root rejected | **A1** |
| 50 m cao | **A1** |

**Answer: 50 m**

## Question 6

| | |
|---|---|
| factorises as $(3x + 4)(x - 6)$ or substitutes correctly into the formula | **M1** |
| one correct root | **A1** |
| $x = -4/3$ or $x = 6$ cao | **A1** |

**Answer: $x = -4/3$ or $x = 6$**

## Question 7

| | |
|---|---|
| correct substitution into the quadratic formula | **M1** |
| -0.873 cao | **A1** |
| 6.87 cao | **A1** |

**Answer: $x = -0.873$ or $x = 6.87$**

## Question 8

| | |
|---|---|
| $(x + 6)^2$ seen | **M1** |
| $(x + 6)^2 = 51$ | **M1** |
| $x + 6 = \pm \sqrt{51}$ | **M1** |
| $x = -6 + \sqrt{51}$ or $x = -6 - \sqrt{51}$ cao | **A1** |

**Answer: $x = -6 + \sqrt{51}$ or $x = -6 - \sqrt{51}$**

## Question 9

| | |
|---|---|
| expands the bracket | **M1** |
| rearranges to $x^2 + 7x + 10 = 0$ | **M1** |
| factorises or substitutes into the formula | **M1** |
| $x = -5$ or $x = -2$ cao | **A1** |

**Answer: $x = -5$ or $x = -2$**

## Question 10

| | |
|---|---|
| $x(x + 3) = 88$ | **M1** |
| $x^2 + 3x - 88 = 0$ | **M1** |
| factorises or solves | **M1** |
| $x = 8$ with the negative root rejected | **A1** |
| 38 m cao | **A1** |

**Answer: 38 m**

## Question 11

| | |
|---|---|
| discriminant $k^2 - 4(9)(1)$ used | **M1** |
| $k^2 = 36$ | **M1** |
| $k = 6$ or $k = -6$ cao | **A1** |

**Answer: $k = 6$ or $k = -6$**

## Question 12

| | |
|---|---|
| $(x + 4)^2$ seen | **M1** |
| $(x + 4)^2 = 5$ | **M1** |
| $x + 4 = \pm \sqrt{5}$ | **M1** |
| $x = -4 + \sqrt{5}$ or $x = -4 - \sqrt{5}$ cao | **A1** |

**Answer: $x = -4 + \sqrt{5}$ or $x = -4 - \sqrt{5}$**

## Question 13

| | |
|---|---|
| expands the bracket | **M1** |
| rearranges to $x^2 - 4 = 0$ | **M1** |
| factorises or substitutes into the formula | **M1** |
| $x = -2$ or $x = 2$ cao | **A1** |

**Answer: $x = -2$ or $x = 2$**

## Question 14

| | |
|---|---|
| $k^2 - 256 > 0$ | **M1** |
| $k^2 > 256$ | **M1** |
| $k < -16$ or $k > 16$ cao | **A1** |

**Answer: $k < -16$ or $k > 16$**

## Question 15

| | |
|---|---|
| correct substitution into the quadratic formula | **M1** |
| -0.370 cao | **A1** |
| 2.70 cao | **A1** |

**Answer: $x = -0.370$ or $x = 2.70$**


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## Question 16

| | |
|---|---|
| expands the bracket | **M1** |
| rearranges to $x^2 - 5x - 14 = 0$ | **M1** |
| factorises or substitutes into the formula | **M1** |
| x = -2 or x = 7 cao | **A1** |

**Answer: x = -2 or x = 7**

## Question 17

| | |
|---|---|
| $x(x + 7) = 120$ | **M1** |
| $x^2 + 7x - 120 = 0$ | **M1** |
| factorises or solves | **M1** |
| x = 8 with the negative root rejected | **A1** |
| 46 m cao | **A1** |

**Answer: 46 m**

## Question 18

| | |
|---|---|
| correct substitution into the quadratic formula | **M1** |
| -3.41 cao | **A1** |
| -0.586 cao | **A1** |

**Answer: x = -3.41 or x = -0.586**

## Question 19

| | |
|---|---|
| attempt to factorise using ac = 20, splitting -12x as -2x-10x | **M1** |
| (2x-1)(2x-5) = 0 oe cao | **A1** |
| x = 0.5 (or 1/2) cao | **A1** |
| x = 2.5 (or 5/2) cao | **A1** |

**Answer: x = 1/2 or x = 5/2**

## Question 20

| | |
|---|---|
| correct substitution into $x = (-b \pm \sqrt{b^2-4ac}) / (2a)$ with a=3, b=5, c=-7 | **M1** |
| discriminant = 109 (or $\sqrt{109}$ = 10.44...) seen | **A1** |
| x = 0.91 awrt | **A1** |
| x = -2.57 awrt | **A1** |

**Answer: x = 0.91 or x = -2.57 (2dp)**

## Question 21

| | |
|---|---|
| correct substitution into $x = (-b \pm \sqrt{b^2-4ac}) / (2a)$ with a=2, b=-7, c=-3 | **M1** |
| x = 3.89 and x = -0.39 (both awrt 2dp) | **A1** |

**Answer: x = 3.89 or x = -0.39 (2dp)**

## Question 22

| | |
|---|---|
| $(x+4)^2$ seen | **M1** |
| $(x+4)^2 - 11$ cao | **A1** |

**Answer: $(x+4)^2 - 11$**

## Question 23

| | |
|---|---|
| correct split of the middle term using ac = -36, e.g. $6x^2 - 9x + 4x - 6$ | **M1** |
| (3x+2)(2x-3) cao | **A1** |

**Answer: (3x+2)(2x-3)**

## Question 24

| | |
|---|---|
| attempt to factorise using ac = -24, splitting 5x as 8x - 3x | **M1** |
| x = 1/2 and x = -4/3 (both values) cao | **A1** |

**Answer: x = 1/2 or x = -4/3**

## Question 25

| | |
|---|---|
| $(x-4)^2 - 16 + 5 (= 0)$ oe | **M1** |
| $(x-4)^2 = 11$ | **M1** |
| $x = 4 \pm \sqrt{11}$ oe (unsimplified acceptable at this stage) | **A1** |
| $x = 4 + \sqrt{11}$ and $x = 4 - \sqrt{11}$ fully simplified surd form cao | **A1** |

**Answer: $x = 4 + \sqrt{11}$ or $x = 4 - \sqrt{11}$**

## Question 26

| | |
|---|---|
| sets $x^2-3x-4 = 2x-8$ | **M1** |
| rearranges to $x^2 - 5x + 4 = 0$ oe | **A1** |
| solves by factorising: (x-1)(x-4) = 0 | **M1** |
| x = 1 and x = 4 (both values) | **A1** |
| correct coordinates (1,-6) and (4,0) cao | **A1** |

**Answer: (1, -6) and (4, 0)**

## Question 27

| | |
|---|---|
| substitutes $u = x^2$ to form $u^2 - 13u + 36 = 0$ | **M1** |
| factorises to (u-9)(u-4) = 0, giving u = 9 or u = 4 | **A1** |
| back-substitutes: $x^2 = 9$ and $x^2 = 4$ | **M1** |
| x = 3 and x = -3 | **A1** |
| x = 2 and x = -2 | **A1** |

**Answer: x = 3, -3, 2, -2**

## Question 28

| | |
|---|---|
| substitutes $u = x^2$ to form $u^2 - 10u + 9 = 0$ | **M1** |
| factorises to (u-9)(u-1) = 0, giving u = 9 or u = 1 | **A1** |
| back-substitutes: $x^2 = 9$ and $x^2 = 1$ | **M1** |
| x = 3 and x = -3 | **A1** |
| x = 1 and x = -1 | **A1** |

**Answer: x = 3, -3, 1, -1**


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